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Title: Deductive Sensemaking Principles Using Personal Constructs of the Field Commanders

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ABSTRACT

The virtue of defining and measuring the commander's performance solely on their "knowledge in their heads" has become an important part of reconstructing battlefield sensemaking process. It is assumed that the expert commander constructs diverse and asynchronous sensemaking models when confronted with asymmetric situations—evolving and changing dynamics of the battlefield information. This personal construct systems are not static—they are confirmed when patterns of old information match the current situational goal, or challenged every moment the commander realizes that everything "held in the head" is no longer relevance—and thus, a new construct system has to be developed quickly to adapt to the new situation. Some of these constructs represent the commander's atypical belief and core values, which can be expressed intuitively by using heuristics, or explanatively by testing wide-ranging hypotheses using mental models. We extend Kelly's construct theory to model the commander's sensemaking process based on his/her field experience. Information from expert interviews with the field commanders from recent conflicts in Iraq and Afghanistan are used to develop the principles of individual sensemaking constructs based on evolving battle situations.

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INTRODUCTION

The commander is a crucial element in the command and control (C2) process. A commander observes the environment (using sensors, information systems, and situation reports from his subordinates) to collect data about his surroundings and the status of enemy and friendly forces. As an adaptive agent, the commander changes his/her tactics and strategies based on evolving situations; and, as a learning agent, the commander formulates some hypotheses, theories, and principles about situations based on experience—both successes and failures. For example, war doctrines are, for the most part, results of the commanders' articulation of lessons-learned and after-fact reports, plus personal constructs which are relative or proportional to the level of experience in combat.

"Commanders are human decision makers who have the ownership/control over their assigned assets, and make decisions about which tasks to select for execution and with which assets. They need to communicate to synchronize assets and decide on task selection and asset employment. The command structure, which specifies authority and supported-supporting relationships among the commanders, is determined by the battalion commander" (Popp, et al., 2005).

Particular types of cognitive processes are required by the commander for the acquisition of conceptual knowledge and the construction of useful principles guiding the behaviors and conduct of battlefield strategies and tactics. For example, Klein et al. (1986) describe a recognition-primed decision-making which captures how experienced people commonly make decisions in their operational settings. Based on observations from five field studies in different domains such as firefighting and tank platoon maneuvers, Klein

and his colleagues found that commanders were often able to quickly size up the situation, arrive at a course of action to deal with it, and modify the course of action as necessary to accommodate changes in the situation.

Commanders are rarely in control over events on the battlefield. The successful general is not the one who carefully implements his original plans, but rather the one who intuitively understands the chaos of the battlefield well enough to take advantage of passing opportunities. Since it is impossible to weigh all of the relevant factors for even the simplest decisions in war, it is the military leader's intuition that must ultimately guide him in effective decision making. Some of this intuitive, *vis-à-vis* analytical decision making processes are often translated into principles (Murdock, 2002), doctrines, and theories that guide the conduct of warfare. For example, principles of command are predicated in part on the commander's understanding of the command and control (C2) process at the three major tier of command hierarchy: strategy, operational, and tactics (Reinhald, 2000). At each of these command hierarchies, command principles are often developed to guide the commander's and battlestaff's methods, techniques, and procedures. For example, US Army Field Manual 3-0 (2003) and FM1 5-0.1 (2006) addresses the Principle of Economy of Force designed to allocate minimum essential combat power to secondary efforts; and, the Principle of Mass, designed to concentrate the effects of combat power at the decisive place and time.

While principles are important part of doctrines of war and military decision making, little or no studies has focused on the understanding of how commanders develop principles that guide their command decision making processes. This paper is focused on this gap. We approach this from two perspectives—from the intrinsic mental dimensions that comprise of sensemaking theories and Kelly's (1955) personal construct theory; and extrinsically from Lewin's (1935) field theory. These various theories are summarized first and their relevance to principle construction elucidated. We present an anecdotal review of sensemaking next.

SENSEMAKING

Our paper is concerned with how commanders construct sensemaking principles. It is therefore natural to introduce sensemaking into our discourse. Sensemaking (SM) can be viewed as a paradigm, a tool, a process, or a theory of how people reduce uncertainty or ambiguity; or to, socially negotiates meaning during decision making events. Weick (1995) states that sensemaking refers to how meaning is constructed at both the individual and the group levels. Through the accurate construction of meaning, clarity increases and confusion decreases. For example, Leedom (2002) indicates that battle rhythms can best be understood through the sensemaking process. A poor sensemaking process often leads to poorly understood objectives, missions, and visions. This in turn can lead to poor framing of plans, and consequently, poor decisions. Ntuen (2006) defines sensemaking as the process of being aware of a situation by using information in context to predict the consequences of the individual and team actions relative to the interpretation and assignment of meaning to that context, while doing so through

progressive enactment of knowledge management process. Thus, SM can take place at the individual or group levels.

Sensemaking to the commander is a combination of many multivariate asynchronous events /activities. Sensemaking is also an aspect of organizational information management that has evolved from many interrelated constructs such as cultural cognition, knowledge management, and quasi-analytic modeling to support diverse intelligent communities concerned with harvesting core knowledge from disparate information sources. The evolutionary process has not been simple. In general, sensemaking targets “Wicked” problem domains which were recognized by Rittel (1973) as constraints in planning of complex-adaptive organizations.

In terms of principle construction, sensemaking is a thinking process that uses retrospective accounts to explain surprises and situational dynamics (Louis,1980). Thomas, et al.(1993; p. 240) describe sensemaking as the “reciprocal interaction of information seeking, meaning ascription and action” (p.240). Sackman (1991) talks about sensemaking mechanisms that organizational members use to attribute meaning to events, mechanisms that include the standards and rules for perceiving, interpreting, believing, and acting that are typically used in a given cultural setting. Feldman (1989) notes that sensemaking is an interpretive process that is necessary for “organizational members to understand and to share understandings about such features of the organization as what it is about, what it does well and poorly, what the problems it faces are and how it should resolve them.” The occasion of the SM process can lead to development of principles or theories about situation characteristics, enactment of actions, or determining conditions about evolving future state of a system.

Principles developed around sensemaking are observed to occur in at least four levels:

- At the cognitive level of the individual, sensemaking reflects the process by which past experience and expertise is used to bracket, label, and attach meaning to significant objects, events, or states in the environment. As part of this process, the individual relates these relatively concrete aspects of awareness to more abstract concepts of purpose, operational focus, and system functionality. The goal of sensemaking at the cognitive level is to form a chain of mental associations that links intent with action.
- At the social level of the organization, sensemaking reflects the process by which individuals: (1) exchange thoughts and ideas to form a common language with which to express meaning; (2) negotiate the relative significance of competing objectives, constraints, and means-ends strategies with respect to the organization’s purpose; (3) conversationally form a unified projection of future events and consequences based on that negotiated understanding; and (4) organize future actions through the communication of plans and directives. In short, organizational sensemaking is a social activity of collaboratively talking a situation into existence and organizing for action.
- At the ecological level of an organization situated within its environment, sensemaking reflects a continuous and interactive process of engaging the environment in order to both (1) map the environment factors to the corresponding held set of beliefs and projections of the sensemaker, and (2) refine

those beliefs through discovery and analysis. These aspects of sensemaking are particularly significant where the organization or work system faces a wicked problem environment. Since “truth” or an optimal solution does not exist within a wicked problem environment, sensemaking can be seen as an iterative, two-way process belief conforming to reality and reality conforming to belief as the work system adjusts to the requisite variety of the environment (Ashby, 1958).

- At the technological level within an organization, sensemaking involves the codification—or externalization—of expertise, awareness, and understanding in the form of a commonly held language. Elements of the language (words and their underlying mental models) will vary in terms of their degree of abstractness versus precise, concrete definitions. Externalized language serves three purposes. First, elements of the language point to internal mental activations and associations within the individual, i.e., it is an expression, albeit an incomplete one, of the individual’s understanding. Second, the elements of the language are a means of communicating the sense of a situation from one individual to another. To the degree that individuals share a common understanding or usage of the language, they will be able to form similar understandings of the current situation. Third, the elements of the language provide the means for public conversation and analysis, either through face to face dialog or through computational algorithms. To the degree that the elements of language are precisely defined, they are amenable to logical predication and analysis; otherwise, they can be used only in an approximate manner to form imprecise—and perhaps erroneous—shared understanding across the work system. The manner in which technology supports organizational sensemaking depends upon how it supports or impedes these roles played by an externalized language.

The distinction between sensemaking paradigms or principles lies in part on how “*what we know*” is communicated—a type of tacit knowledge that is internal or explicit knowledge that is shared. As a process, sensemaking represents our “knowing-how”, the explicit part of knowledge, and “knowing-that” represents the tacit counterpart. The explicit knowledge, then, is essentially the application of what we know (Ryle 1984, p. 25-61). Knowing-how or process sensemaking is characteristic of the expert, who acts, makes judgments, and so forth without explicitly reflecting on the principles or rules involved. As Dretske has pointed out (Dretske 1988, p. 116), knowing-how involves more than just a certain technical or physical “know-how”; it also involves knowing how to obtain desired end-states, knowing what to do in order to obtain them, and knowing when to do it. The focal knowledge posited by Polanyi (1966) forms the theoretical basis for describing the enactment of sensemaking process into an actionable knowledge, using different principles. According to Polanyi focal knowledge is a form of articulated knowledge made explicit through implementation of actions—therefore, resulting in some observable behaviors.

To summarize, the commander’s sensemaking process can be observed to occur along a chain of linked cognitive tasks. These are, e.g, event association, significant cue recognition, and understanding the situation enough to enact actions. These tasks are also mediated by environmental factors or battlefield factors the mediate the sensemaking

process at each of the cognitive tasks. We shall now discuss the Field factors that arise from the battlefield events.

FIELD THEORY

In field theory, we postulate that the commanders operate in a action-reaction system—strategizing and taking actions against threat environment (offense), and, at the same token, being mindful of countering threats (defensive reaction) from the enemy possible attacks. All action-reaction decisions are basically dependent on the experience of the commander, the more experienced, the shorter (and perhaps accurate) the decisions are; and the less experienced, the longer time it takes to make a decision (and perhaps so, less accurate). The quantitative properties of such action-reaction energy field are basically dependent on the experience (or relative cognitive distance between event (action or reaction) and the type of environment (e.g., asymmetric versus conventional force-on-force battlefield). This assertion has its root from Lewin's (1935) concept of "force field" in social psychology.

According to Lewin (1935, 1936), in every experience, we acquire knowledge. Knowledge is communicated by building compelling interactions with others or with tools so that the patterns and meanings in their information can be learned by others. Lewin (1936) viewed the social environment as a dynamic field which impacted in an interactive way with human consciousness. In his field theory, *a 'field' is defined as 'the totality of coexisting facts which are conceived of as mutually interdependent'* (Lewin 1951; p240). Lewin saw people behave differently according to the way in which tensions between perceptions of the self and of the environment were worked through. Thus, the whole psychological field, or 'lifespace', within which people acted, had to be viewed, in order to understand behavior. Lewin (1935) conducted many action field research studies to understand social problems. Lewin drew from physics and mathematics to construct his theory. From physics he (like the Gestaltists) borrowed the concept of the field, positing a psychological field, or "life space," as the locus of a person's experiences and needs. The life space becomes increasingly differentiated as experiences accrue. Lewin adapted a branch of geometry known as topology to map the spatial relationships of goals and solutions contained in regions within a life space. The field theory as observed by Deaux and Writtsman (1988) is the *"proposition that human behavior is the function of both the person and the environment."* This means that one's behavior is related both to one's personal characteristics and to the social situation in which one finds oneself.

Hesse (1970, p. 181) and Rummel (1975, p. 26) suggest that field theory may be said to have the following characteristics:

- It purports to explain changes in the states of some elements (e.g. a static field induces motion in a charged particle) but need not appeal to changes in states of other elements (that is, "causes"). *In the battlefield equivalent, the commander's judgment and decision is time dependent since information about the adversary is not static.*

- These changes in state involve an interaction between the field and the existing states of the elements (e.g. a particle of positive charge moves one way and one of negative charge another). *In the battlefield equivalent, the commander's interaction with the battlefield elements is the arbiter of experience that controls and mediates decision making.*
- The elements have particular attributes which make them susceptible to the field effect (particles differ in the degree and direction of charge). *In the battlefield equivalent, the commander makes judgment based the level of effect desired relative to the field information, e.g., directions of the risk vector.*
- The field without the elements is only a potential for the creation of force, without any existent force (Hesse 1970, p. 196). *In the battlefield equivalent, a commander will recreate battle scenarios and substitute combat genres to control potential areas of agitation—a sort of anticipated plan.*
- The field itself is organized and differential (Koffka 1935, p. 117). In other words, at any position the field is a vector of potential force and these vectors are neither identical nor randomly distributed. *In the battlefield equivalent, the commander views every sector of battlefield differently, applying different control elements designed to deliver the necessary effect.*

Tolman (1948) expanded Lewin's theory to model psychological interface between roles and culture. This is true of the modern asymmetric war in Iraq where culture and non-military factors have become dominant forces to be reckoned with by the commander. For example, understanding civil intelligent which is composed of clan networks, insurgent networks, family genres and allegiances, the scope of stability operations, perception of religious values and norms of Islamic life styles, and an understanding of how to map new military doctrines, such as the PEMSII (Political, Economic Military, Social, Infrastructure, Information) into strategy vectors which are defined by the DIME (Diplomatic, Infrastructure, Military, and Economic) factors. According to Tolman, the region of the commanders' behavior space is controlled by the possible cultural implications while responding to a stimulus situation from the perspective of the region emitting the stimuli. For example, this region may consist of an insurgent attack on a mosque or a militant occupation of oil production refinery. In both cases, the commander's response is different, and the desired effect is also different.

We have shown that, like physics, force field factors have profound effects on our sensemaking of our surround. It believed that, the more people encounter similar environments over time, the more likely we can frame some principles to describe the behaviors of such environments. More so, we can interpret information from the environment based what Lewin(1936) called "life spaces." It is the components of these life spaces that allow people to construct theories, models, and paradigms about situated events or the 'world' in context.

KELLY'S PERSONAL CONSTRUCTS THEORY (PCT)

In Kelly's personal construct theory, the expert develops a repertoire of constructs as a pattern matching algorithm between the latent/ innate tacit knowledge and the information in the environment. Kelly uses "*the term construct in a manner which is*

somewhat parallel to the common usage of concept" (1955). The expert constructs in this case, represent some form of judgment or evaluation. "Man is a scientist", said Kelly, in that he is always building up and refining theories and models about how the world works so that he can anticipate events. People develop internal models of reality, called *constructs* in order to understand and explain the world around them in the same way that scientists develop theories. Like scientists, they develop these constructs based on observation and experimentation. Constructs thus start as unstable conjecture, changing and stabilizing as more experience and proof is gained. The key message of the Personal Construction Theory (PCT) is that the world is perceived by a person in terms of sensemaking--whatever meaning that a person applies to a situation. Kelly maintained that a person is capable of applying alternative constructions (meanings) to any events in the past, present, or future. At the level of system structure, PCT suggests that meaning is a matter of contrast - an individual attributes meaning to an event not only by construing what it is, but also by differentiating it from what it is not.

As a phenomenological construct, an individual (personal identity) is defined by the way we construe or understand our personal worlds. Within Kelly's construct, (a) the individual creates his or her own ways of seeing the world in which he lives; (b) the individual builds constructs and tries them on evolving contexts; (c) the construct can be applied to the same events in different contexts or by forcing the construct to adapt to new events; and (d) the individual's practical systems have particular foci and limited ranges of convenience. All these possibilities, notes Peterson (1967), demonstrate that man is also an intuitive statistician who forms concepts, observes the behaviors of a phenomenon, and makes some conclusions based on collected data. These assertions, then, when applied to the expert commander, defines the perspectives in which a commander builds his or her personal constructs within his/her science laboratory which resides in the head and mind, and represents the battlefield.

The interaction of human mind-space and the environment led Kelly to introduce the notion of a psychological space as a term for a region in which we may place and classify elements of our experience. It is important to note that he did not suppose this space to pre-exist as a world of such elements, but rather to come into being through a process of construction by which we create a space in which to place elements as we come to construe them. Kelly presented his theory as *geometry of psychological space* (Kelly, 1969). Figure 1 shows a simplified version of such a space in a military environment.

By using the mind of the commander as the spatial geometry, we can see that such cognitive items as the belief space (Bonet and Geffner, 2000), assumptions, bias (Gordon, et al., 1995), and the overall formulation of strategies, are viewed as pieces of jiz-saw puzzle space. In Kelly's assertion, we see the space as a dichotomous reference axis—the dualism that defines the commander's sensemaking, vis-à-vis decision-making ability, e.g., attack/do not attack, defend/offense, etc. Accordingly, "*A person's construction system is composed of a finite number of dichotomous constructs.*" (Kelly, 1955; p.59)

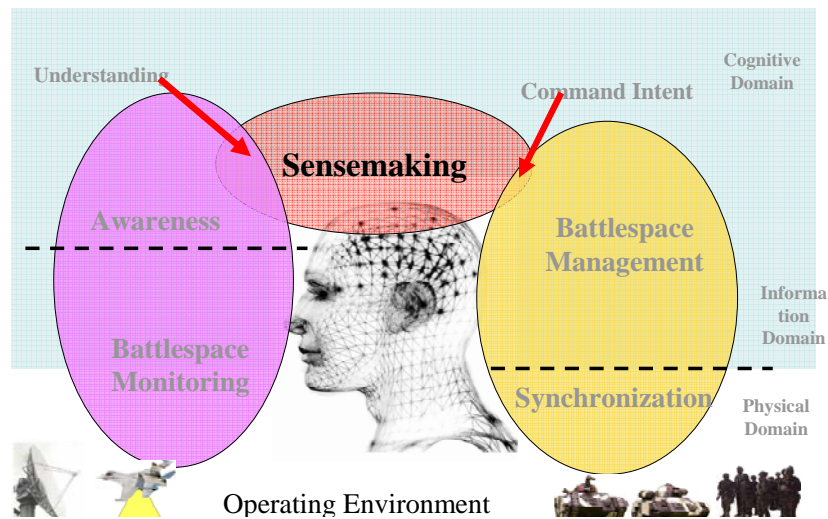


FIGURE 1. A SIMPLIFIED PSYCHOLOGICAL SPACE OF THE COMMANDER DURING SENSEMAKING (adapted from Leedom, 2004)

Kelly argued that people invent and re-invent an implicit theoretical framework, a personal construct system about any aspect of their lives. People construct theories of their reality and test these out as the state of the world changes (Bannister and Mair, 1968; p. 5). We understand events through a variety of constructions. These events are given individual meanings through the way we make sense of them in our personal construct system. People continually refine and update their views of the world. Their ways of construing the world include the informal theories that they have about their practice. Based on his studies, Kelly's (1955) formulated many fundamental postulates for personal construct psychology that are important to our study of the commander's sensemaking principles. Some of these are:

- "Constructs are used for predictions of things to come, and the world keeps on rolling on and revealing these predictions to be either correct or misleading. This fact provides the basis for the revision of constructs and, eventually, of whole constructs systems." (Kelly, 1955; p.14)
- "A person's processes are psychologically channelized by the way in which he anticipates events." (Ibid, p.46)
- "A person anticipates events by construing their replications." (Ibid, p.50)

In Kelly's construct theory, we are reminded that commanders are experts who behave as scientists. When battlefield events occur, they will formulate some hypotheses about possible situations, develop mental courses of action (while also supported by analytical courses of action developed by the battlestaff) as events unfolds in time and space. Thus, it is asserted here that the human mind and its mental models are equivalent to the force field since they are constructed as an ongoing process of retrospective sensemaking. The

next section will summarize some sensemaking principles based on the commander's personal experience of battlefields.

SENSEMAKING PRINCIPLES OF THE FIELD COMMANDERS

Subjects:

The participants are military officers from the rank of major top full colonel. They have been a part of an on-going conflicts in Iraq and Afghanistan; and they have commanded brigades and below.

Methods:

The commanders were selected for interview at SAMS located at Fort Leavenworth. The Each commander was interviewed at a time for a period that lasted between 2 to 4 hours. The commanders were asked to describe a scenario, use both verbal protocols and link diagrams to express and illustrate situations. The interviewed subject spoke in terms of both general "lessons learned" and specific critical incidents that he was personally involved in.

Sample Case Scenarios:

The first incident involved the interview subject serving as the battalion commander in charge of planning operations in the eastern side of Ar Ramad (designated the "Tamin 5Kilo" Area). This incident involved a humanitarian assistance mission for some Kurds that were located in a Kurdish village in a predominately Sunni area. During this mission, the unit came to understand some of the important cultural differences between the Kurds, Sunnis, and Shia. The village had previously been under the control of the United Nation (UN), but these forces were no longer in the area. There was also a nearby Sunni village. The interview subject began with the comment that the senior leaders in the Army (and those in charge of National Training Center (NTC) still have the old linear battlefield mindset. If you haven't been to Iraq lately, you probably don't understanding the modern operating environment. It is critical to visualize what effects you want to achieve before you go downrange.

Some Issues and Occasions for Sensemaking Reported by Battlefield Commanders

The participating commanders were ask to verbalize or write the main issues related to the above scenario in terms of how the understand and make sense of the based on the interrelated doctrines of dealing with civil affairs. The following six viewpoints provide a summary.

- One of the biggest issues was information management within the Tactical Operation Center (TOC) and contributing to the operational commanders' decision cycle. While the TOC personnel knew what was going on, the challenge was getting the right information out to the operational commanders on the ground (what information did they need to have for their decision processes?).

- The critical incident involved a cordon and search operation planned against a block-style apartment complex known as the “Chinese Apartments” that were filled with various insurgent cells. Previously, the brigade had never had a consolidated picture of what was going on inside the apartments, only isolated reports of cell phones, Improvised Electronic Device (IED) material, etc.
- The crew had very limited combat power in the town they were supposed to focus on.
 - The scattered deployment of the troop created vulnerable Lines of Combats (LOC) that came under constant attack as they attempted to keep each battalion logistically supplied. Some of the battalions were located in remote areas which prevented them from contributing to the main focus, the securing of the Provincial capital. Thus, the first major decision of the commander focused on changing the operational strategy which resulted in a shift from a disperse control to a more coordinated control with established center of gravity (COG).
 - The first critical incident described a fratricide event that occurred while two battalions were advancing toward a common waypoint in a wedge formation. The battalion task force on the right should have been tracking its position with respect to the middle of the lead task force. Instead, the battalion task force on the right advanced too rapidly and moved to a position ahead of the lead battalion. At this point, an element of the lead battalion engaged one of the tanks from the other battalion and continued firing until ordered to cease by its company commander (the interview subject). Maintaining control and developing understanding of this situation was hindered by the command channel being blocked by a “hot mike” (a tactical radio microphone has been inadvertently left in the transmit position), thus blocking others from using the command channel for coordination. The company commander had to physically run his tank into the shooting tank in order to get the attention of the tank commander.
 - The second incident was a 2-company cordon and search operation focused in the Tamin area. The operational intent was to reduce IED attacks along MSR-X.
 - The third intent was to integrate the Iraqi Army forces into the operation to a greater extent as time went on.
 - The fourth incident involved a night company-size “presence patrol” along Highway 1 from Ad Dujayl towards Bayji. The middle tank was hit by an RPG and the unit engaged insurgents in the field to the west of the highway. After initially controlling the situation, the unit began a search for the insurgents, thought to be hiding in a stream area. Initially, the company commander controlled the operation. After 5 minutes, the battalion S-3 arrived, and then the battalion commander. At first, several of the tank crews dismounted and began to search for insurgents. Eventually, a 10-12 man team of infantry was dispatched to search (they found one wounded insurgent).

The preceding section presents a summarized review of many sensemaking strategies that were judged to be consensus across all the commanders in the study. The next section is a table that summarizes some principles developed from both the PCT (tacit knowledge component) and Field Theory (external knowledge component),

A SET OF EMERGING SENSEMAKING PRINCIPLES FROM INTERVIEWED COMMANDERS

As alluded to earlier, we can, in theory organize sensemaking principles based on whether the occasion for sensemaking is controlled by *internal factors (tacit knowing) enabled by Kelly's personal constructs or by external factors (focal knowing that leads to collective knowledge)* as enabled by Lewin's field theory. This is organized in Table 1 below.

Table 1. Sensemaking Principles by Theoretical Constructs

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
Principle 1: Commanders organize information by creating their own heuristics to suit the context they are dealing with, including referent to doctrines and rules of operation	Principle 2: Commanders deal with a situation at a time, leading to synchronic concept of operations—dealing with the incumbent adversary one at a time—alternations and continuation of actions over time represents new and evolving event	Principle 3. Commanders combine many cognitive 'sights' in dealing with the sensemaking process. Foresight, insight, hindsight, oversight, Table 2 (<i>Ntuen, 2006</i>) illustrates the use of this principle.
Principle 4: Commanders are experts. According Ericsson & Lehmann (1966), " <i>Experts don't just automatically extract patterns and retrieve their response directly from memory. Instead, they select the relevant information and encode it in special representations....that allow planning, evaluation and reasoning about alternative courses of actions.</i> "	Principle 5. Commanders think of actions and consequences of the actions with respect to end state. They think of delivering force to achieve the maximum effect. Proportionality is something of neutrality—just enough to neutralize the enemy actions.	Principle 6: The commander's sensemaking of a specific battle situation is bounded by reflective knowledge of history, situational information, and beliefs that sustain operational actions and their involvement in those actions. <i>The commander adapts the relevant past knowledge to current situations and design new ones in novel situations</i> (Truer, et., 1999).
Principle 7: Commanders are intuitive statisticians (Peterson, 1967). They represent a notional understanding of adversary by constructing sensemaking patterns and statistical footprints of events through the use of analogy, concept mappings, and link analysis	Principle 8: The commander's perception of risk consequences to own troops play a vital role in commitment of troops and resources to fight war. Minimum risk means troop safety first	Principle 9: Uncertainty is an inseparable part of battlefield sensemaking and decision making. Commanders tend to see uncertainty in two lenses—one that sees threats and another that sees opportunities. Threats are near-term, while opportunities are long-term tensions. Under uncertain dimensions, judgment and decisions rarely achieve finality.

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
Principle 10: The commander constructs a model of performance based on execution capability of his troops and the relevance of the mission. Such effort includes the ability of battlestaff to interpret the commander's intent, knowledge to understand the mission and decision, concrete and abstract knowledge of how to implement actions with less guidance, and the ability to deploy the available resources optimally while achieving maximum battle effect	Principle 11: Organizational artifacts of various kinds—such as rules, culture, doctrines, and authority structure, and so on—play a central role on how commanders make sense of the battlefield.	Principle 12: Sensemaking, decision-making, and action co-exist during periods of battle—you can not do one without the other—and their cycle of interaction is continuous during the execution of the battle.
Principle 19: Commanders use self knowledge to cope with evolving battlefield situations. They often develop situation handling heuristics to deal with ensuing problems	Principle 20: Commanders sensemaking is through the doctrinal filters and regulations	Principle 21: Commanders are ambidextrous leaders. The ambidextrous individuals are multi-taskers with the capability to response to uneventful conditions taking place at various locations of the organization—including external noise
Principle 22: The commander is an information processing sensor who consumes and uses multivariate information in the sensemaking process		Principle 23: Commanders often seek a balance between theory (doctrines, standard operating procedures, etc) generated from organizational constructs and the reality of the battlefield; the latter overrides the former during stressful tasks.
Principle 24: The commander's interpretation of the battle situation is an ongoing process—dynamically changes at discrete time intervals to cope with the adversary strategies and tactics. <i>At any moment, situation interpretation and meaning assignment evolves around three-tier abstract dimensions of physical, informational, and cognitive levels of processing (FM1 5-0.1).The cognitive dominates everything else.</i>		Principle 25: The commander updates his/her belief according to the current situation awareness and seeks information to support the belief updating strategy.

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
		Principle 26: The commander views the sensemaking process as an ongoing execution monitoring loop. This loop is a culmination of all the components of battlespace visualization elements—Visualize, Decide, Design, Act. During different phases of the battle life cycle, the commander sensemaking is translated into a situation-handling process of monitoring the battle information dynamics, analyzing the information, providing guidance for decisions and actions and recommended corrective adjustments when required
		Principle 27: Commanders visualize the battlespace as a continuous close-loop of goal-action links anchored primarily on the mission statements.
		Principle 28: Commanders develop different situation understanding and situation handling mechanisms relative to the task assigned

The summary of the principles on Table 1 is by no means complete. It is true that different commanders have different concepts of a battle situation. However, through training doctrines, these differences are minimized. In general, it is the commander's perception or mental sights of the situation (Ntuen, 2006) that mitigate the individual sensemaking process. Table 2 below provides sample explanations.

Table 2. The commander's sight of the battle command as explained by principle 6 above.

Sighted (cognition)	Knowledge Type	Explanations/ Applications
Foresight	Fore knowledge	Envisioning and predicting mental causal maps for situations and/or events. Applied to planning during contingencies, alleviating constraints/bottlenecks, and perceiving dimensions of system failure at the conceptual stage. Useful in constructing simulation models.

Sighted (cognition)	Knowledge Type	Explanations/ Applications
Insight	Tacit knowledge	Supports meta-cognition using knowledge-based models—mental models, cognitive maps, heuristics generated from experiential knowledge. Useful in constructing mental simulation through explorative proof-of-concept on expertise and derivative knowledge of familiar situations.
Hindsight	Introspective knowledge	Heavily bounded on intuitive-behavioral continuum. The “light bulb” is on by instant discovery.
Oversight	Diagnostic knowledge	There is an overshoot caused by the gap in knowledge between the reality and model-based situation assessment. The interest is to diagnose causes and consequences of error during the sensemaking process.
Outsight	Focal knowledge	Thinking outside of the box. Imagining the impossible scenarios, events, and their consequences.

Table 2 above represents the aspects of tacit knowledge (based on PCT) and the field factors such as those defined by “outsight” knowledge. These “sights” are prevalent and they do significantly moderate the sensemaking process. It is surmised that these sights represent the dynamic knowledge structures of the commander while developing plans for an on-going operation. It is believed that each of the sights are evoked by intuition-- a "vague feeling of knowing something without knowing exactly how or why."

DISCUSSIONS AND CONCLUSIONS

Changing characteristics of the battlefield environments and the availability of information technology is transforming the commander to a knowledge-based field worker. He must stay both agile and adaptive—using meta-cognitive processors to determine which components of the current model in his head is relevant to incumbent situations; and how he/she can influence the battle dynamics from his experienced strategies. The commander as a single individual is operating with her tacit knowledge while under the influence of battle “field” forces. The commanders develop some coping mechanisms, among them is the tendency to work from guiding rules or experience or principles.

This paper has attempted to discover these principles through the process of private interviews with experienced commanders. It is argued that the battlefield environments in

which the commander operates have characteristics similar to conditions explained in Lewin's field theory, Kelly Personal Construct Theory and theory of expertise. From Kelly's PCT, the commander operates in action-reaction space and in doing so, must develop a coping mechanism with the ability to (a) anticipate future state of nature; (b) cope with state changing in the battlefield; and (c) replicate past experiences and map them into problem space to determine patterns and linkages. From Lewin's field theory: (a) changes of state in the battlefield are influenced by ecological niches which must be considered in delivering effects; (b) Each change of state in the system induces new coping requirements by the commander—leading to new set of experience; (c) The effects of each change of system state vary in proportion to the commander's experience—where the most experience commander can literally absorb the effects through a good sensemaking process; and (d) The battle "field" has distributed vectors of potential forces that are randomly distributed which lead to non symmetric sensemaking processes by the commander—each evolving state must be attended to by understanding the weight of each vector in the field (e.g., risk, resources required, etc.).

It is believed in our study—though literature reviews reveal that minimal or nearly no existing study has been done to understand how commanders cope in the battlefield through self-made, home-breed (heuristic) principles that are often developed to guide their actions. In our personal interviews with the commanders upon their return from Iraq and Afghanistan, we have identified at least twenty one of such principles as they relate to their sensemaking processes. It is observed that, contrary to traditional war environment of "force –on-force" the commanders rely more on their meta-cognitive processes to cope with information system in the battlefield that is hitherto recognized to be "wicked" and asymmetrically dynamic in every aspect of events and anticipations. One application of our study is to shed light into improvement opportunities which can be realized through development of training doctrines based on the experiences of the field commander.

Some examples of those opportunities are:

- Using the commander's near accurate mental models of the tactical situations to build a good situational awareness to support situations when available information is intermittent or ambiguous.
- Understand the principal attributes of commanders' - and battlestaffs' - sensemaking processes.
- Develop training programs for the battlestaff to quickly recognize situations and adapt with agility to evolving contexts using codified expertise mental models.
- Develop sensemaking support tools that can connect to different expert perspectives while allowing for efficient search for common mental models available for a situation.

ACKNOWLEDGMENT:

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DEDUCTIVE SENSEMAKING PRINCIPLES USING PERSONAL CONSTRUCTS OF THE FIELD COMMANDERS

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Presentation Outline

1. INTRODUCTION
2. RELATED DEFINITIONS OF SENSEMAKING
3. RELATING WAR PRICIPLES TO THE SENSEMAKING PROCESS
4. TWO PSYCHOLOGICAL THEORIES SUPPORTING SENSEMAKING DEDI+UCTIVE PRINCIPLES
5. A STUDY OF THE SENSEMAKING PRINCIPLES OF THE FIELD COMMANDER
6. SUMMARY & CONCLUSIONS



INTRODUCTION

It is by the eyes of the mind,
By reasoning over the whole,
By a species of inspiration that the general sees,
Knows and judges
(Napoleon Bonaparte)

One who employs strategic power (shih)
Commands men in battle as if he were rolling logs and stone (Sun-Tzu)

A number of assumptions or suppositions must be made about a variety of
things which do not actually appear,
But which in all probability did take place,
And therefore cannot possibly be left out of consideration,
By my experience, I see these things (Carl Von Clausewitz)

Fighting is one thing
Intelligence is another.
Each requires different qualities, not often found in the same person
(John Keegan: Intelligence in War).



Common ideas about knowledge and deductive principles

Inductivism: Science proceeds by performing experiments repeatedly, and accumulating observations.

Then it makes inductive generalizations from the accumulated facts. These are the laws of science. (Francis Bacon)

Hypothetico-Deductivism: Science proceeds by devising hypothetical models for how nature might really be organized. Then it deduces the consequences of these models, and compares them with observation.

Deductive and Inductive logic are two examples of several logics we use to “make sense” of the world around us.



Principles:

A basic truth, law, or assumption

e.g: Principles of democracy

A rule or standard

e.g., Military decision making process

A fixed or predetermined policy or model of action

e.g., Army doctrines



WHAT IS SENSEMAKING ?

Sensemaking: A process, design, or techniques of fusing information in context to derive understanding.

Making Sense: The art or science of making meaning and/ or interpreting information in context for decision making.



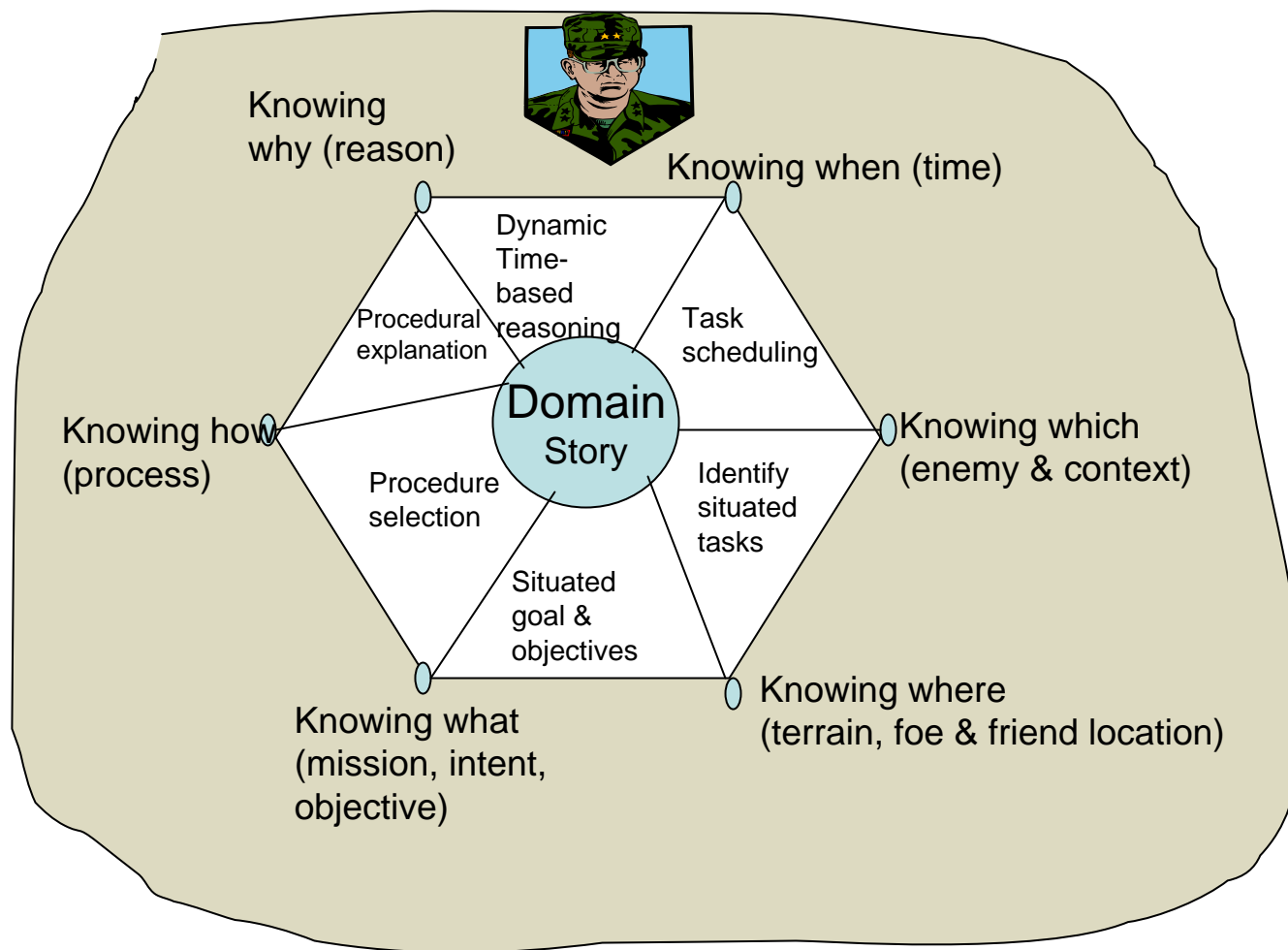
WHAT IS SENSEMAKING ?

Among the several definitions, two are Selected

HOW MEANING IS CONSTRUCTED AT BOTH THE INDIVIDUAL & THE GROUP LEVELS – (Weick, 1995).

DERIVING MEANING FROM FRAGMENTARY CUES—

(DARPA'S Information Awareness Project



Our Sensemaking Inquiry System Research Architecture



THE COMMANDER'S SENSEMAKING KNOWLEDGE COMPONENTS

Hindsight:

The commander relies in hindsight—elements of experiential knowledge; lessons-learned data; “I have seen this before syndrome”

Insight:

The commander relies on tacit knowledge—“knowing more than he can tell;” the “aha” experience

Foresight:

The commander attempts to project his knowledge into the future through envisioning, anticipated (expected goals). A product of mental simulation

Short-sight:

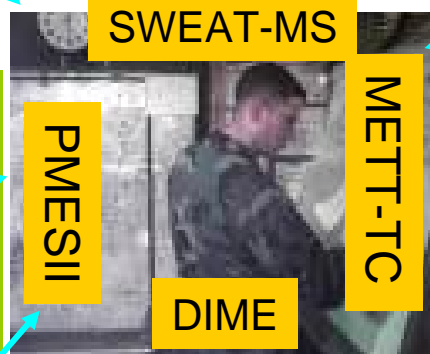
The commander relies on short-term goals; Lacks discernment or long-range planning perspective.

Oversight:

The commander overestimates/ Underestimates situation—unintentional omission or mistake.

Outsight:

The commander looks for outside information to confirm his beliefs—HUMINT, SIGMINT, etc. “What is happening out there syndrome”

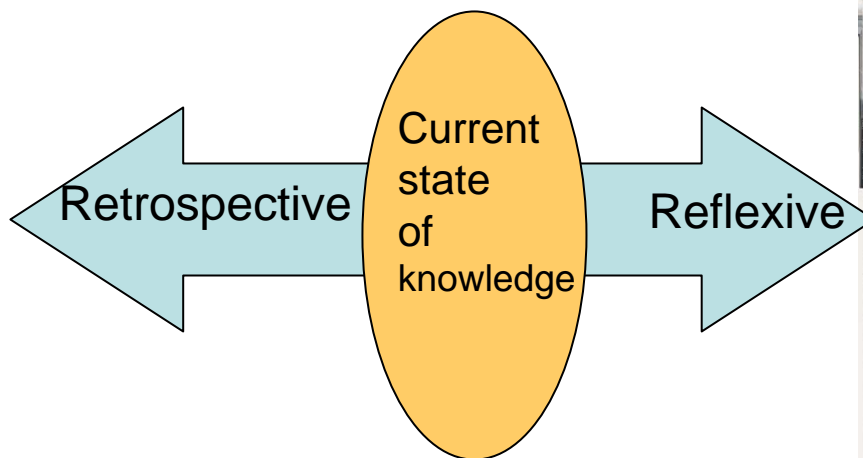


The Adversary

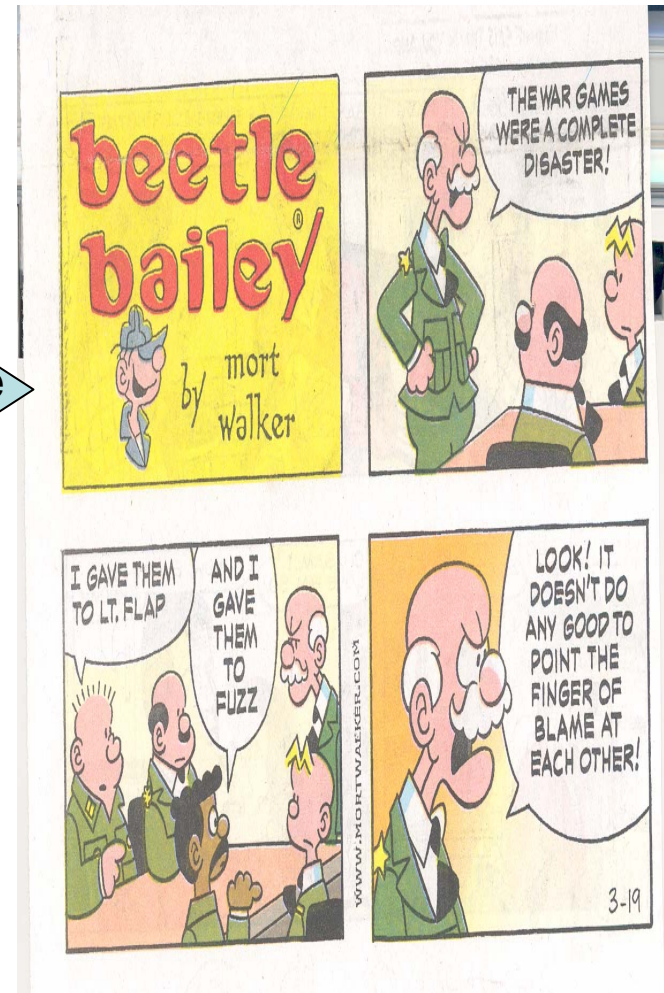


Relating War Principles to the Sensemaking Process

1. Cognitive Level:



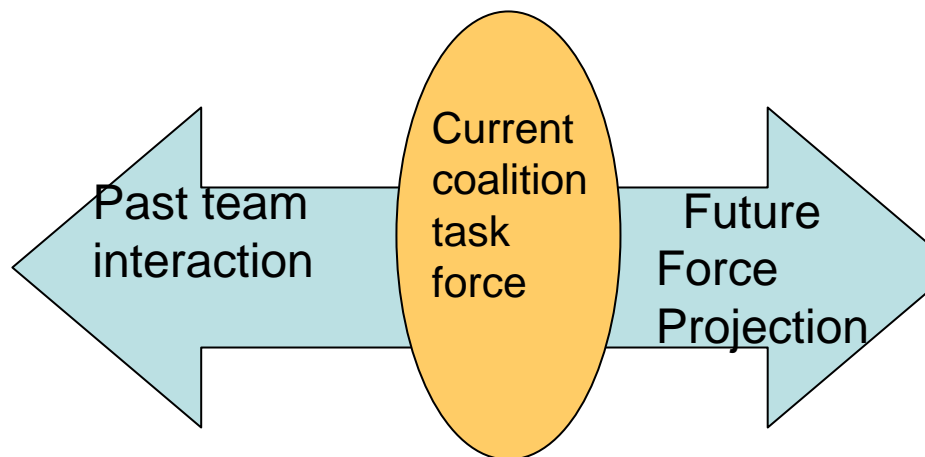
- Use past experience, mental model to establish meanings to situations
- Forms a chain of mental map, link concepts, and gain situation awareness





Relating War Principles to the Sensemaking Process

2. Social Level



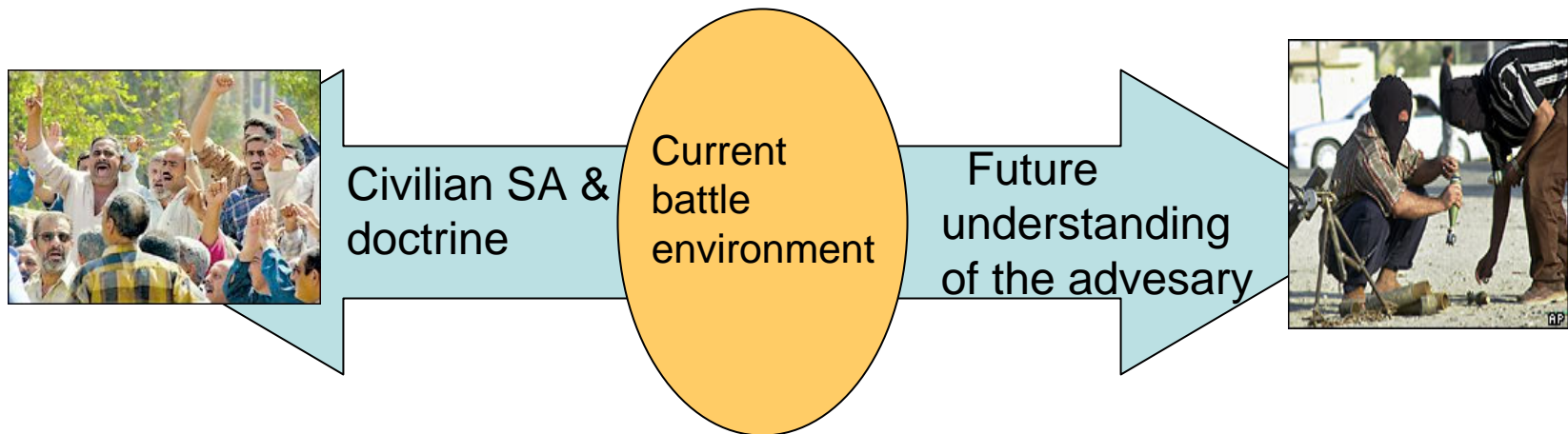
- Information exchange
- Establish a common language
- Negotiate meaning and common understanding
- Organize future events based on roles and common operating picture





Relating War Principles to the Sensemaking Process

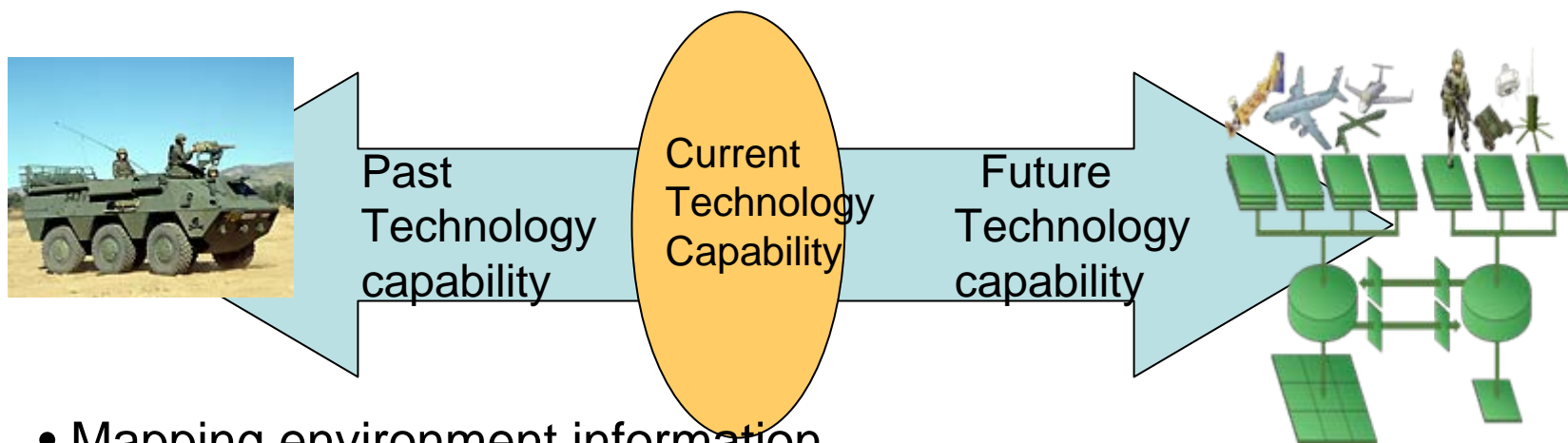
3. Ecological Level



- Mapping environment information to beliefs of the sensemakers
- Revising beliefs to discover new trends and behaviors.
- Adjust beliefs to fit the “requisite variety” of the environment

Relating War Principles to the Sensemaking Process

4. Technology Level



- Mapping environment information to beliefs of the sensemakers
- Revising beliefs to discover new trends and behaviors.
- Adjust beliefs to fit the “requisite variety” of the environment



TWO PSYCHOLOGICAL THEORIES SUPPORTING SENSEMAKING DEDUCTIVE PRINCIPLES

Field Theory (Lewin, 1935, 1936)

1. In every experience, we acquire knowledge.
2. The social environment is a dynamic field
 1. A field is the totality of coexisting facts which are conceived of as mutually independent
3. The psychological field consists of a totality of human experience or life space.
4. The geometry of the life space can be constructed using mental map: how one experience influence another—over time and space.



TWO PSYCHOLOGICAL THEORIES SUPPORTING SENSEMAKING DEDUCTIVE PRINCIPLES

Field Theory (Lewin, 1935, 1936)

5. A life space is subject to change in states (Hesse, 1970; pp. 181).

e.g., the commander's judgment and decision is time and context dependent.

6. The objects in the life space interact with social space to create or enable new experience

e.g., the new civil affairs doctrine for the military is a result of experience in Iraq war—bringing cultural and civil experience to stability operations

PEMSII (Political, economic, Military, Social, Infrastructure, Military)

DIME (Diplomatic, Infrastructure, Military, & Economic)



TWO PSYCHOLOGICAL THEORIES SUPPORTING SENSEMAKING DEDUCTIVE PRINCIPLES

Field Theory (Lewin, 1935, 1936)

7. Every judgment and decision is subject to constraints created by field forces (e.g., magnetic polarities, yin-yan interactions).
e.g., effect-based operations are occasioned by the level of expectations and directions of risk factor.
8. The force field is organized and differentiated.
e.g., battlefield sectorization with different control factors.



Personal Construct Theory (Kelly, 1955)

1. The experienced commander develops a repertoire of constructs, algorithms, and principles to explain every situations that may arise.
2. Construct is similar to our common use of concepts
“Man as a scientist” uses concepts to build and refine theories of the situated worlds, and give explanantion based on experience.
3. Personal Construct Theory (PCT) –the world is perceived by a person in terms of whatever meaning that person applies to a situation (through the sensemaking process): variations occur at different levels of information abstraction and levels of tasks

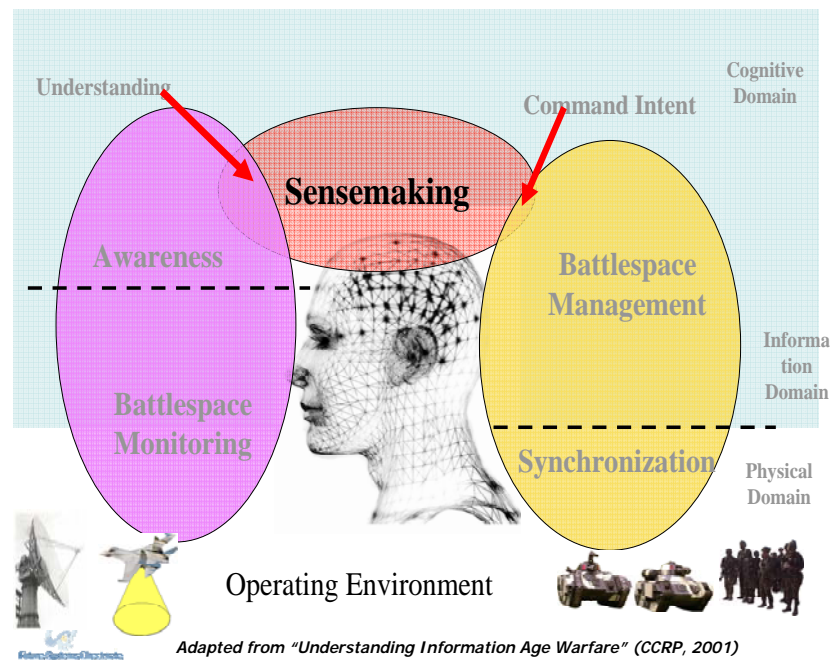


Personal Construct Theory (Kelly, 1955)

4. PCT is a phenomenological in that an individual's personal identity help us recreate the personal worlds:
 - (a) The individual creates his or her own ways of seeing the world;
 - (b) The individual uses his or experience to cope with evolving circumstances;
 - (c) The individual attempts to use his or experience as a a theory construction for new situations;
 - (d) The individual belief system influences the use of experience in making decisions.

Personal Construct Theory (Kelly, 1955)

5. A person's construction system is composed of a finite number of dichotomous constructs (pp. 59):
Attack/do not attack,
Defense/offense, etc.



6. Constructs are used for predictions, to anticipate events, and for Testing theories of what we think we know about new situations



SENSEMAKING PRINCIPLES OF THE FIELD COMMANDERS

Subjects: 6 military commanders from the rank of major to full colonel. They are (have) participated on an on-going conflicts in Iraq and Afaghistan; and have command experience at brigade level or below.

Sample Scenarios:

Humanitarian Mission for some Kurds located at a predominantly Sunni area. During the mission, the unit came understand some important cultural differences between the Kurds, Sunnis, and Shia. The village has been previously under the UN forces who have since evacuated the area. The commanders were asked to give an assessment of urban civil population, describe the relationships between their background of the war situation, cultural intelligence, and integrate models of terrain, cultural/civil, and cognitive states of the operation.



SENSEMAKING PRINCIPLES OF THE FIELD COMMANDERS

Data Collections.

Interview using media style

Open-ended questionnaires with write in, self explanation

Using and constructing personal mental maps with
significant links

Issues that impact sensemaking:

1. Poor information sharing between TOC (Tactical operation Center) and field commanders.
2. Poor transition between status quo doctrines and the new civil / cultural doctrines.



SENSEMAKING PRINCIPLES OF THE FIELD COMMANDERS

Issues that impact sensemaking:

3. Poorly coordinated center of gravity (CoG) to response to unpredicted attacks by insurgents or Sunni-Kurdish “unfriendly” elements.
4. Maintaining control and developing understanding of likely combat situations.
5. Maintaining stability along the humanitarian zone.



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
<p>Principle 1: Commanders organize information by creating their own heuristics to suit the context they are dealing with, including referent to doctrines and rules of operation</p>	<p>Principle 2: Commanders deal with a situation at a time, leading to synchronic concept of operations—dealing with the incumbent adversary one at a time—alternations and continuation of actions over time represents new and evolving event</p>	<p>Principle 3. Commanders combine many cognitive ‘sights’ in dealing with the sensemaking process. Foresight, insight, hindsight, oversight, Table 2 (Ntuen, 2006) <i>illustrates the use of this principle.</i></p>



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
<p>Principle 4: Commanders are experts. According Ericsson & Lehmann (1966), <i>“Experts don’t just automatically extract patterns and retrieve their response directly from memory. Instead, they select the relevant information and encode it in special representations....that allow planning, evaluation and reasoning about alternative courses of actions.”</i></p>	<p>Principle 5. Commanders think of actions and consequences of the actions with respect to end state. They think of delivering force to achieve the maximum effect. Proportionality is something of neutrality—just enough to neutralize the enemy actions.</p>	<p>Principle 6: The commander’s sensemaking of a specific battle situation is bounded by reflective knowledge of history, situational information, and beliefs that sustain operational actions and their involvement in those actions. <i>The commander adapts the relevant past knowledge to current situations and design new ones in novel situations</i> (Truer, et., 1999).</p>



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
Principle 7: Commanders are intuitive statisticians (Peterson, 1967). They represent a notional understanding of adversary by constructing sensemaking patterns and statistical footprints of events through the use of analogy, concept mappings, and link analysis	Principle 8: The commander's perception of risk consequences to own troops play a vital role in commitment of troops and resources to fight war. Minimum risk means troop safety first	Principle 9: Uncertainty is an inseparable part of battlefield sensemaking and decision making. Commanders tend to see uncertainty in two lenses—one that sees threats and another that sees opportunities. Threats are near-term, while opportunities are long-term tensions. Under uncertain dimensions, judgment and decisions rarely achieve finality.



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
Principle 10: The commander constructs a model of performance based on execution capability of his troops and the relevance of the mission. Such effort includes the ability of battlestaff to interpret the commander's intent, knowledge to understand the mission and decision, concrete and abstract knowledge of how to implement actions with less guidance, and the ability to deploy the available resources optimally while achieving maximum battle effect	Principle 11: Organizational artifacts of various kinds—such as rules, culture, doctrines, and authority structure, and so on—play a central role on how commanders make sense of the battlefield.	Principle 12: Sensemaking, decision-making, and action co-exist during periods of battle—you can not do one without the other—and their cycle of interaction is continuous during the execution of the battle.



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
<p>Principle 19: Commanders use self knowledge to cope with evolving battlefield situations. They often develop situation handling heuristics to deal with ensuing problems</p>	<p>Principle 20: Commanders sensemaking is through the doctrinal filters and regulations</p>	<p>Principle 21: Commanders are ambidextrous leaders. The ambidextrous individuals are multi-taskers with the capability to response to uneventful conditions taking place at various locations of the organization—including external noise</p>



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
Principle 22: The commander is an information processing sensor who consumes and uses multivariate information in the sensemaking process		Principle 23: Commanders often seek a balance between theory (doctrines, standard operating procedures, etc) generated from organizational constructs and the reality of the battlefield; the latter overrides the former during stressful tasks.



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Principles attributed to internal factors (Personal construct)	Principles attributed to external factors (field theoretic)	Personal construct and field theory
<p>Principle 24: The commander's interpretation of the battle situation is an ongoing process—dynamically changes at discrete time intervals to cope with the adversary strategies and tactics. <i>At any moment, situation interpretation and meaning assignment evolves around three-tier abstract dimensions of physical, informational, and cognitive levels of processing (FM1 5-0.1).The cognitive dominates everything else.</i></p>		<p>Principle 25: The commander updates his/her belief according to the current situation awareness and seeks information to support the belief updating strategy.</p>



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Personal construct and field theory

Principle 26: The commander views the sensemaking process as an ongoing execution monitoring loop. This loop is a culmination of all the components of battlespace visualization elements—Visualize, Decide, Design, Act. During different phases of the battle life cycle, the commander sensemaking is translated into a situation-handling process of monitoring the battle information dynamics, analyzing the information, providing guidance for decisions and actions and recommended corrective adjustments when required



EMERGING SENSEMAKING PRINCIPLES FROM THE FIELD COMMANDERS

Personal construct and field theory

Principle 27: Commanders visualize the battlespace as a continuous close-loop of goal-action links anchored primarily on the mission statements.

Principle 28: Commanders develop different situation understanding and situation handling mechanisms relative to the task assigned



THE COMMANDER'S SIGHT OF THE BATTLE COMMAND AS EXPLAINED BY THE PRINCIPLES

Sighted (cognition)	Knowledge Type	Explanations/ Applications
Foresight	Fore knowledge	Envisioning and predicting mental causal maps for situations and/or events. Applied to planning during contingencies, alleviating constraints/bottlenecks, and perceiving dimensions of system failure at the conceptual stage. Useful in constructing simulation models.
Outsight	Focal knowledge	Thinking outside of the box. Imagining the impossible scenarios, events, and their consequences.



THE COMMANDER'S SIGHT OF THE BATTLE COMMAND AS EXPLAINED BY THE PRINCIPLES

Sighted (cognition)	Knowledge Type	Explanations/ Applications
Hindsight	Introspective knowledge	Heavily bounded on intuitive-behavioral continuum. The “light bulb” is on by instant discovery.
Oversight	Diagnostic knowledge	There is an overshoot caused by the gap in knowledge between the reality and model-based situation assessment. The interest is to diagnose causes and consequences of error during the sensemaking process.
Outsight	Focal knowledge	Thinking outside of the box. Imagining the impossible scenarios, events, and their consequences.



SUMMARY / CONCLUSIONS

1. The commander, as an individual, depends on his or her tacit knowledge to cope with battlefield dynamics
2. These dynamics are further influenced by “social forces) and “field forces”.
3. It is surmized that the commander, then, develops some guiding rules or principles based on experience to cope with the dynamics of the battlefield.



SUMMARY / CONCLUSIONS

4. Lewin field theory and Kelly's personal construct theory provide the basis for understanding the commander's personal view of the battlefield.
5. Understanding the commander's construct is useful to many C2 situations:
 - Design of decision systems that reflect the mental models of the commanders in different situations—a sort of expert system for the decision maker.
 - Understand how the commander make sense of situations (from simple, complex, and wicked)



SUMMARY / CONCLUSIONS

- Develop training programs for the battlestaff to quickly recognize situations and commander's intent.
- Develop sensemaking tools that can connect to different expert perspectives while allowing for efficient search for common mental models available for a situation.